

CLAIMS

1. A computer implemented simulation and evaluation method for simulating interventions including active and passive intervention to a complex system, such as a patient having a set of normal and abnormal conditions such as a health state, by a user, and for evaluating the interventions responsive to predetermined criteria and the interventions, comprising the steps of:

- (a) accessing the computer implemented simulation and evaluation method by the user;
- (b) defining a test area to evaluate the user by the computer implemented simulation and evaluation method responsive to at least one of predetermined criteria and a user profile;
- (c) selecting genetic information of the patient responsive to the test area;
- (d) generating a patient history responsive to the test area and the genetic information;
- (e) receiving at least one intervention input by the user; and
- (f) evaluating the user responsive to the at least one intervention input by the user and the predetermined criteria.

2. A computer implemented simulation and evaluation method according to claim 1, further comprising the steps of:

5 (g) evolving the patient responsive to the at least one intervention, the genetic information and the patient history to at least one subsequent health state; and

(h) evaluating the user responsive to the at least one intervention input by the user, the at least one subsequent health state, and the predetermined criteria.

3. A computer implemented simulation and evaluation method according to claim 1, further comprising the steps of:

5 (g) evolving the patient responsive to the at least one intervention, the genetic information and the patient history to at least one subsequent health state; and

(h) receiving at least one other intervention input by the user; and

10 (i) evaluating the user responsive to at least one of the at least one intervention input by the user, the at least one other intervention input by the user, the at least one subsequent health state, and the predetermined criteria.

4. A computer implemented simulation and evaluation method according to claim 1, further comprising the steps of:

5 (g) evolving the patient responsive to the at least one intervention, the genetic information and the patient history to at least one subsequent health state;

(h) receiving at least one other intervention input by the user;

10 (i) evolving the patient responsive to the at least one intervention, the genetic information and the patient history to at least one other subsequent health state; and

15 (j) evaluating the user responsive to at least one of the at least one intervention input by the user, the at least one other intervention input by the user, the at least one subsequent health state, the at least one other subsequent health state, and the predetermined criteria.

5. A computer implemented simulation and evaluation method according to claim 1, wherein said generating step (d) further comprises the step of generating the patient history responsive to the test area, the genetic information, and an entity relationship model.

6. A computer implemented simulation and evaluation method according to claim 5, wherein the entity relationship model comprises population, record, agents of change, health states, findings and courses of action.

7. A computer implemented simulation and evaluation method according to claim 6, wherein the findings include specific findings, patterns and sub-patterns describing patient behaviors and characteristics.

8. A computer implemented simulation and evaluation method according to claim 7, wherein the patterns describe one or more features over time.

9. A computer implemented simulation and evaluation method according to claim 7, wherein the sub-patterns describe consequences of patient related events.

10. A computer implemented simulation and evaluation method according to claim 7, wherein the patterns model time and characterize interrelated medical observations.

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11. A computer implemented simulation and evaluation method according to claim 7, further comprising the step of performing a differential diagnosis responsive to the findings, the patterns and the sub-patterns.

12. A computer implemented simulation and evaluation method according to claim 7, wherein confidence in a presence of the patterns increases with passage of time.

13. A computer implemented simulation and evaluation method according to claim 6, wherein the courses of action describe tasks and methods used to apply, modify, and evaluate health state information and characteristics described in the entity relationship model.

14. A computer implemented simulation and evaluation method according to claim 6, wherein the courses of action describe patient activities, including at least one of medical and non-medical activities.

15. A computer implemented simulation and evaluation method according to claim 6, wherein the courses of action describe potential interventions input by the user including at least one of diagnostic and management strategies.

16. A computer implemented simulation and evaluation method according to claim 6, wherein the courses of action comprise one or more elementary courses of action used in to construct at least one course of action, one or more 5 types of elementary courses of action corresponding to the one or more elementary course of action, and weighting factors corresponding to the one or more elementary courses of action.

*E* ~~17. A computer implemented simulation and evaluation method according to claim 5, wherein the entity relationship model includes entity relations.~~

18. A computer implemented simulation and evaluation method according to claim 17, further comprising the step of evolving the patient responsive to the at least one intervention, the genetic information, the entity 5 relations and the patient history to at least one subsequent health state.

19. A computer implemented simulation and evaluation method according to claim 5, wherein the entity relationship model includes a health states leads to health states relation describing patient evolution.

20. A computer implemented simulation and evaluation method according to claim 5, wherein the entity relationship model includes one or more of the following relations between entities:

5           Population Contacts Population  
Population Related to Population  
Population Interacts with Courses of Action  
Population Exposed to Agents of Change  
Population Has Health States  
Population Exhibits Findings  
10           Agents of Change Cause Health States  
Health States Lead to Health States  
Findings Associated with Health States  
Findings Link to Findings  
15           Course of Action use Agents of Change  
Courses of Action Identify Agents of Change  
Courses of Action Treat Health States  
Courses of Action Alter Findings  
Courses of Action Reveal Findings  
20           Courses of Action Evaluate Findings.

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21. A computer implemented simulation and evaluation method according to claim 6, wherein the entity relationship model links the findings with the patterns to a health state, rather than linking a range of finding values to the health state.

22. A computer implemented simulation and evaluation method according to claim 6, wherein the patterns include sensitivity and specificity represented as age dependent, rather than as constants.

23. A computer implemented simulation and evaluation method according to claim 1, wherein said generating patient history step (d) is executed once for each simulation to generate the patient history used in said computer implemented simulation and evaluation method.

24. A computer implemented simulation and evaluation method according to claim 2, further comprising the step of repeating said evolving step (g), and said receiving step (h) a plurality of times.

25. A computer implemented simulation and evaluation method according to claim 1, wherein said generating step (d) generates the patient history comprising a progression of health states and risk factors traversed by the patient 5 from a normal health condition to a specified health condition.

26. A computer implemented simulation and evaluation method according to claim 1, wherein said generating step (d) iteratively generates the patient history backwards in time from a specified health condition to a normal health condition including successive precursor health states and onset times therebetween. 5

27. A computer implemented simulation and evaluation method according to claim 1, wherein said generating step (d) generates the patient history using a Monte Carlo process to multiple stochastic trees to generate a 5 plurality of potential patient histories to be used in said computer implemented simulation and evaluation method.

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28. A computer implemented simulation and evaluation method according to claim 5, wherein the entity relationship model utilizes tree structures to describe a probability density function conditioned on comorbidities, treatments, risk factors, and the interventions.

29. A computer implemented simulation and evaluation method according to claim 5, wherein the entity relationship model includes diagnostic complexities and disease interaction.

30. A computer implemented simulation and evaluation method according to claim 5, wherein the entity relationship model includes parallel networks of health states to avoid combinatoric health state explosion.

31. A computer implemented simulation and evaluation method according to claim 30, wherein the parallel networks of health states describe at least one of a chronic condition and non-chronic condition.

32. A computer implemented simulation and evaluation method according to claim 30, wherein the non-chronic condition includes acute exacerbations describing acute flares of illness that occur during a more chronic health condition.

33. A computer implemented simulation and evaluation method according to claim 30, wherein the parallel networks of health states form at least one of the following interactions:

- 5 (1) independent interaction between the parallel networks so that patient evolution between first and second parallel networks are unrelated to each other;
- 10 (2) unilateral interaction between the parallel networks so that patient evolution on a first parallel network is unrelated to the patient evolution on a second parallel network, and patient evolution on the second parallel network is related to the patient evolution on the first parallel network; and
- 15 (3) mutually dependent interaction between the parallel networks so that patient evolution between the first and second parallel networks are related to each other.

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34. A computer implemented simulation and evaluation method according to claim 2, further comprising the step of repeating said evolving step (g) to the at least one subsequent health state is responsive to:

5 (1) parallel health states of the patient; and  
(2) a target health state and health state combinations that lead to different parallel health states.

35. A computer implemented simulation and evaluation method according to claim 30, wherein the parallel networks of health states comprise:

5 (1) a primary network including primary health conditions defining a health domain;  
(2) a risk factor network including risk factors for progression through the primary network; and  
(3) complications attributed to treating the primary health conditions in the primary network.

36. A computer implemented simulation and evaluation method according to claim 35, wherein the parallel networks of health states are generated using the following information:

5                   (1) how long at least one of the risk factors exists before influencing a transition between primary health conditions in the primary network;

10                  (2) time required for transitions in the primary network, considering different combinations of the risk factors; and

15                  (3) number of transitions the patient is allowed to make between a specified health state and a normal health state.

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37. A computer simulation and evaluation system for simulating interventions including active and passive intervention to a patient having a health state by a user, and for evaluating the interventions responsive to predetermined criteria and the interventions, comprising:

5 a knowledge database storing patient health

characteristics including at least one of population, record, agents of change, health states, findings and courses of action;

10 a presentation system providing access to the computer simulation and evaluation system by the user; and

a patient simulation system adapted to be connectable to said presentation system and said knowledge database, said patient simulation system performing the functions:

15 (a) defining a test area and selecting genetic information of the patient responsive to the test area and the knowledge database;

(b) generating a patient history responsive to the test area and the genetic information;

20 (c) receiving at least one intervention input by the user; and

(d) evaluating the user responsive to the at least one intervention input by the user and the predetermined criteria.

38. A computer readable tangible medium storing  
instructions for implementing a process driven by a  
computer, the process simulating interventions initiated  
by a user, the interventions including active and passive  
interventions to a patient having a health state, and the  
process evaluating the interventions responsive to  
predetermined criteria and the interventions, the  
instructions comprising the steps of:

- (a) accessing the computer implemented simulation and evaluation method by the user;
- (b) defining a test area to evaluate the user by the computer implemented simulation and evaluation method responsive to at least one of predetermined criteria and a user profile;
- (c) selecting genetic information of the patient responsive to the test area;
- (d) generating a patient history responsive to the test area and the genetic information;
- (e) receiving at least one intervention input by the user; and
- (f) evaluating the user responsive to the at least one intervention input by the user and the predetermined criteria.

39. A computer implemented simulation and evaluation method simulates interventions to a patient by a user, and evaluates the interventions responsive to predetermined criteria and the interventions, said method comprising the steps of defining a test area to evaluate the user responsive to at least one of predetermined criteria and a user profile, selecting genetic information of the patient responsive to the test area, generating a patient history responsive to the test area and the genetic information, receiving at least one intervention input by the user, and evaluating the user responsive to the at least one intervention and the predetermined criteria.

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